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# FREQUENCY DEVIATION CONVERTER

MODEL 13-4618-00 & 13-G4618-00

GOULD
Electronics

GOULD
*Electronics*

MANUAL PART NO
13-804618-00

# FREQUENCY DEVIATION

# CONVERTER

MODEL 13-4618-00 & 13-G4618-00

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**Gould Inc., Instruments Division**
3631 Perkins Avenue, Cleveland, Ohio 44114

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PRINTED IN U.S.A.

# SAFETY SUMMARY

The general safety information is for both user and service personnel. Specific **WARNINGS** and **CAUTIONS** will be found throughout the manual where they apply.

## TERMS IN THIS MANUAL

**CAUTION** statements identify conditions or practices that could result in damage to the equipment or other property. They will appear in boldfaced capital letters.

**WARNING** statements identify conditions or practices that could result in personal injury or loss of life. They will appear in boldfaced capital letters.

## SYMBOLS IN THIS MANUAL

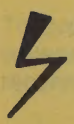
This symbol indicates where cautionary information is to be found.

## TERMS AS MARKED ON EQUIPMENT

**CAUTION** indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property, including the equipment itself.

**DANGER** indicates a personal injury hazard immediately accessible as one reads the marking.

## SYMBOLS AS MARKED ON EQUIPMENT



DANGER - High Voltage.

Protective ground (earth) terminal.

ATTENTION - Refer to manual.

## POWER SOURCE

This instrument is intended to operate from a power source that does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential.

## GROUNDING THE INSTRUMENT

This instrument is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

## DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

## USE THE PROPER POWER CORD

Use only the power cord and connector specified for your instrument. Use only a power cord that is in good condition. For detailed information on power cords and connections see Section 2, Installation, in the User's Manual.

## USE THE PROPER FUSE

To avoid fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in the parts list for your instrument.

## DO NOT OPERATE WITHOUT COVERS AND PANELS INSTALLED

To avoid personal injury and equipment damage, the user should disconnect power before removing covers, panels or any grounding straps. Reinstall covers, panels, and any grounding straps *before* reconnecting power.

## *WARNINGS* FOR AUTHORIZED SERVICE PERSONNEL

Do not perform internal service or adjustment of this instrument unless another person capable of rendering first aid and resuscitation is present.

Dangerous voltages exist at several points in this instrument. To avoid personal injury, do not touch exposed connections or components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

# WARRANTY

All products manufactured and sold by Gould Inc., Test and Measurement Group are warranted to conform to the applicable published specification in effect at the time of shipment, and to be free from defects in material or manufacture for the applicable period set forth in the table below, when used with recommended Gould associated equipment and/or supplies. If any such product proves defective during the applicable warranty period, Gould, at its option, will either repair the defective product without charge for parts and labor or provide a replacement in exchange for the defective product.

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In order to obtain service under this warranty, Buyer must notify Gould or its designated service center of the defect before the expiration of the warranty period and make suitable arrangements for either the return of the defective product or on-site performance of service. Buyer shall be responsible for packaging and shipping the defective product, transportation prepaid, to Gould's designated service center. Gould will provide on-site performance of warranty service only upon prior agreement and subject to payment of an additional charge by Buyer. Warranty work is performed Monday thru Friday, 8:00 a.m. to 5:00 p.m.

Gould reserves the right to determine the cause and existence of a defect under this warranty and this warranty shall not apply to any products which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, inundation, fire or operation outside their published maximum ratings.

| Product Category | Warranty Period |
|---|---|
| Analog & Digital Oscilloscopes | 2 YEARS from date of shipment |
| Logic Analyzers*, Oscillographic Recorders, Strip Chart Recorders, Array Recorders, Waveform Recording Products, DASA Data Acquisition (AT computers), DASA Data Acquisition (Accessories), Analog XY Recorders, Monitor Scopes & Digital Displays, Chart Paper. | 1 YEAR from date of shipment |
| Digital Plotters | 6 MONTHS from date of shipment |
| 5300 Series Programmable Waveform Recorders | 25 MONTHS from date of shipment |

*Except for disk drive memory storage devices which are warranted for 90 days

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REPLACEMENT PARTS: Warranty is same as above except ninety (90) days from date of shipment.

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Compliance with the above procedure will assure the earliest repair and return of your equipment.

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- Field maintenance
- NBS Certification

**Training**

- Instruction of operators
- On-site training seminars
- Formal Training courses

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- Fixed Fee
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Today, Gould recorders and signal conditioners are the overwhelming choice for recording analog signals in the most critical industrial, scientific, and biophysical measurement applications. Whether recording the faintest life signals of a patient in a hospital operating room or the most critical variables in the lab or on the production line, you can depend on the accuracy, faithfulness, clarity, and permanence of the traces made by Gould recorder.

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Owing to the various requirements of each customer, we do not reproduce here a standard boilerplate agreement -- which might contain too much or too little. Instead, we tailor each contract to a particular customer's needs. This practice has singlehandedly produced substantial savings in time and money for others, and it can do the same for you.

An extended warranty is available at the point of sale allowing a regulated budget for the first two years of ownership. You may take advantage of this warranty within the first year of ownership at a percentage of the current listed price.

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# SECTION I

# GENERAL INFORMATION

## 1.1 SCOPE

This manual contains specifications, installation and operating instructions for the Gould Frequency Deviation Converter, Model 13-4618-00. In addition a theory of operation, calibration procedures and a parts breakdown is included.

## 1.2 INTRODUCTION

### 1.2.1 Description

The Gould Frequency Deviation Converter (Figure 1-1) is a single channel, plug-in signal conditioner. It measures the frequency deviation from a center frequency of 50, 60 or 400 Hz and develops a 0 to ±2.5 volt dc output signal proportional to the deviation. The converter was designed for plug-in operation with Gould 2000 Series direct writing recorders. When so used, it receives operating power directly from the pendrive amplifier of the recorder channel it serves. This reduces converter complexity, eliminates power supply noise pickup, and improves reliability.

This converter is not limited to operation with Gould 2000 Series recorders. When powered from a standard dc power supply that provides ±15 volts of suitable quality, it can be used with any Gould recorder or other readout device with similar input characteristics.

Numerous applications for this signal conditioner include: checking the stability and accuracy of low frequency signal sources in the laboratory; monitoring the speed regulating governors and electronic synchronizing equipment on turbo-generators; and checking the ac systems in emergency or remote power units, aircraft, and on shipboard.

Since it is a continuous monitoring unit with fast response, the Gould Frequency Deviation Converter is especially useful for detecting fluctuations in frequency due to system instability, step changes in load, switching of transmission lines, and synchronizing electric power generators.

Common mode rejection of 120dB for dc voltages and 80dB at 60Hz permits operation in noisy industrial environments.

The customary input voltage selector switch has been eliminated, since the high impedance input circuit will accept any ac voltage from 10 to 500 volts rms continuously, and will safely reject voltage transients of much greater values.

The factory calibrated, dc output is ±2.5 volts full scale into 2 kilohms or greater, on all sensitivity ranges. This output is electrically compatible with any Gould direct writing recorder or other readout device with similar input characteristics.

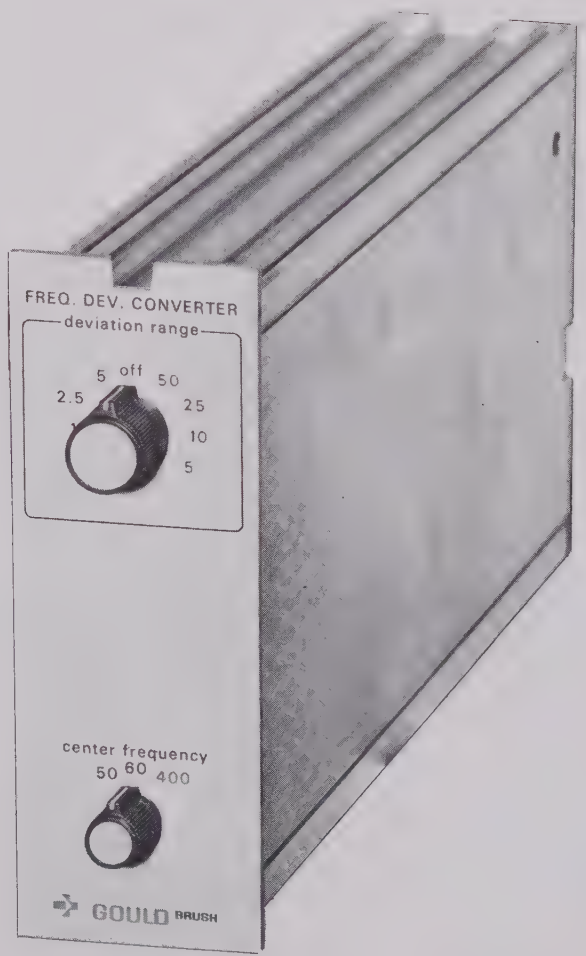



FIGURE 1-1 GOULD MODEL 13-4618-00 FREQUENCY DEVIATION CONVERTER

### 1.2.2 Important Features of the Frequency Deviation Converter

1. Excellent frequency resolution of up to 1/100 Hz per chart division*.
2. Three center frequencies permit operation at 50, 60 or 400Hz.
3. Accepts any voltage from 10 to 500 volts rms.
4. High voltage isolation of 1,500 volts peak ac or dc from input to ouput.
5. Response time of less than 100 milliseconds.
6. High input impedance of 100,000 ohms.
7. Range Inaccuracy of better than ±0.2%.
8. Deviation Range Switch provides four full scale sensitivity ranges for each center frequency. For center frequencies of 50 or 60Hz, these ranges are ±0.5, ±1, ±2.5, and ±5Hz. For a center frequency of 400 Hz, the full scale sensitivity ranges are ±5, ±10, ±25, and ±50 Hz.

*Operating at 50 or 60Hz and displayed on Gould 100-division graphic chart.

### 1.3 Specifications

Converter Input

Converter Configuration ..... Floating Differential 1500V peak ac or dc isolation to chassis.

Impedance ..... 100K ohms ±5% 20 watts.

Input Voltage ..... 10V to 500V rms

Maximum Safe Voltage .....1000 volts peak ac or dc

Center Frequencies .....50, 60 or 400Hz ±0.025%.

Converter Output

Measurement Ranges ..... 49.5-50.5, 49-51, 47.5-52.5 or 45-55Hz; 59.5-60.5, 59-61, 57.5-62.5 or 55-65Hz; 395-405,390-410, 375-425 or 350-450Hz.

Circuit Configuration ..... Single ended to common.

Output Voltage .....±2.5vdc into 2000 ohms or greater.

Calibration Inaccuracy ..... ±.1% most sensitive range.
Range Switch Inaccuracy ..... ±.2%.
Zero ..... 0 vdc output at center frequency.

Output Impedance ..... Less than 1 ohm.

Non-Linearity ..... Within .1% of range.

| Instability (After 30 Min. warmup) | ZERO | GAIN |
|---|---|---|
| Time | .02% of CF/24 hr. | .02%/24 hr. |
| Temp | .02% of CF/°C | .08%/°C |
| Power Supply | .01%/1% Change | |

Frequency Bandwidth ..... Less than 3dB DN @ 3 Hz 12 dB/Octave roll off.

Rise Time ..... < 100 ms (10 to 90%).

Overshoot ..... < 0.5%.

Common Mode Rejection ..... >120dB @ dc, 80dB @ 60Hz at 100V input.

Output Noise ..... < 10mv rms most sensitive range.

Environment

Temperature

Storage ..... -40 to 70° C.

Operating ..... 0 to 50° C.

Humidity (Operating) ..... 95% to +35° C (+95° F) non-condensing relative humidity.

Vibration and Shock ..... Best commercial practice.

Physical Characteristics

Dimensions ..... 15.3 cm high x 28 cm long x 5.6 cm wide.

Weight ..... 1.4 Kg (3 lb).

Mounting ..... Retained from rear.

Finish ..... Molded front panel.
Color - Light parchment.

Power Requirements

DC Voltage ..... ±15 volts ±1 volt @ 100ma.

System Specifications when used with Series 2000 Recorders

Gain Accuracy ..... 0.3%.

Non-Linearity ..... 0.45% of full scale range.

| Instability | ZERO | GAIN |
|---|---|---|
| Time | 0.1% CF/24 hrs. | 0.1%/24 hrs. |
| Temp | 0.045% CF/° C | 0.13%/° C. |
| Line | 0.1% CF/10% | 0.5%/10% |

Frequency Response ..... See Converter specifications.

Noise ..... < 25mv

Maximum Safe Input Voltage ..... 750V Peak ac or dc.

Common Mode Rejection . . . . . .120dB @ dc, 80dB @ 60Hz at 100V input.

**1.4 Supplies and Accessories**

Supplied with converter

Input Connector (Male) . . . . . 11-5407-02

Optional-may be ordered separately

Extender Card and Cable Assembly . . . . . 887291

Input Connector Adapter. Converts input connector to 3 "binding post" terminals . . . . . 11-5407-09

Input Connector Adapter. Converts input connector to 6-pin Cannon connector receptacle . . . . . 11-5407-06

# SECTION II

# INSTALLATION

## 2.1 GENERAL

This section describes inspection checks to be made upon receipt of the Gould Frequency Deviation Converter, Model 13-4618-00 with a 2000 Series Recorder. It covers installation procedures, signal input connections, and outline dimensions.

## 2.2 INITIAL INSPECTION

Prior to attempting any electrical connections or operation visually examine the unit for broken or loose knobs, dented or nicked panels and broken or chipped rear connectors.

## 2.3 INSTALLATION

Converter Model 13-4618-00 may be mounted in Gould 2000 Recorder frames, or rack mounted separately in a Gould preamplifier enclosure.

### 2.3.1 Insertion

To install the converter into its appropriate slot:

a. Slide the converter into the enclosure until the rear output card edge connector is engaged.

b. Tighten the rear retaining screw. This locks the converter into the enclosure.

c. Connect the plastic input signal connector and secure it by turning the threaded plastic locking ring clockwise.

### 2.3.2 Removal

a. Disconnect the input connections with a counterclockwise turn and pull.

b. Loosen the rear retaining screw. The converter will move forward about 1/8 of an inch.

c. Carefully slide the entire converter out of the Gould 2000 enclosure.

## 2.4 SIGNAL CONNECTIONS

### 2.4.1 General

Gould converter Model 13-4618-00 has a fully floating, high impedance input circuit of 100K ohms; electrical isolation of 1500 volts from input to output; and the ability to accept any ac waveform from 10 to 500 volts rms.

### 2.4.2 Input Connection Hardware

**NOTE: For signal input connections, use the special connector provided with the converter (Gould part number 11-5407-02).**

Connections to the converter are made at the rear. (Figure 2-1). A good signal cable should be used with single pair twisted and shielded.

### 2.4.3 Output and Power

The amplifier is designed to operate on + and -15 volt, 100ma regulated supplies. Output and power connections are provided through a 16 pin card edge on the rear of the converter (Figure 2-1). The mating connector is located in the recorder chassis.

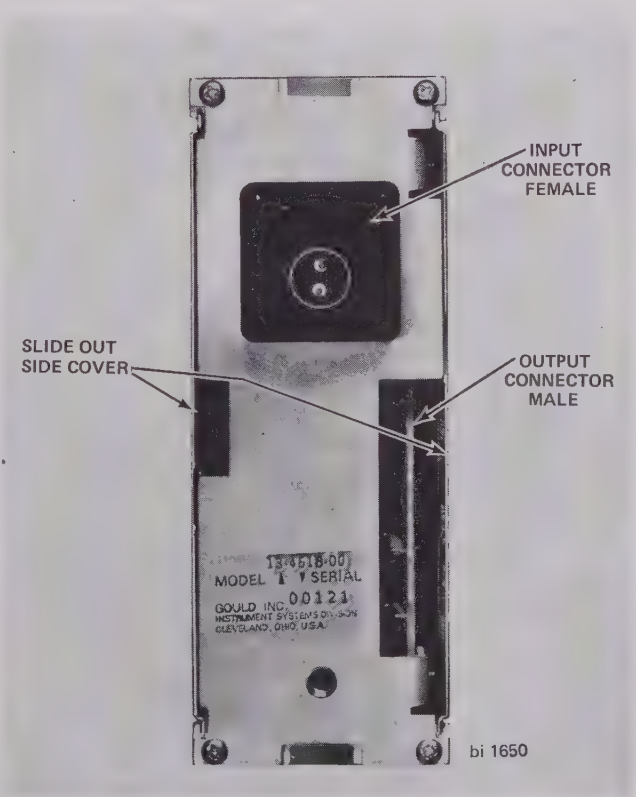



FIGURE 2-1 REAR VIEW

## 2.5 OUTLINE DIMENSIONS

Refer to Figure 2-2 for outline dimensions.

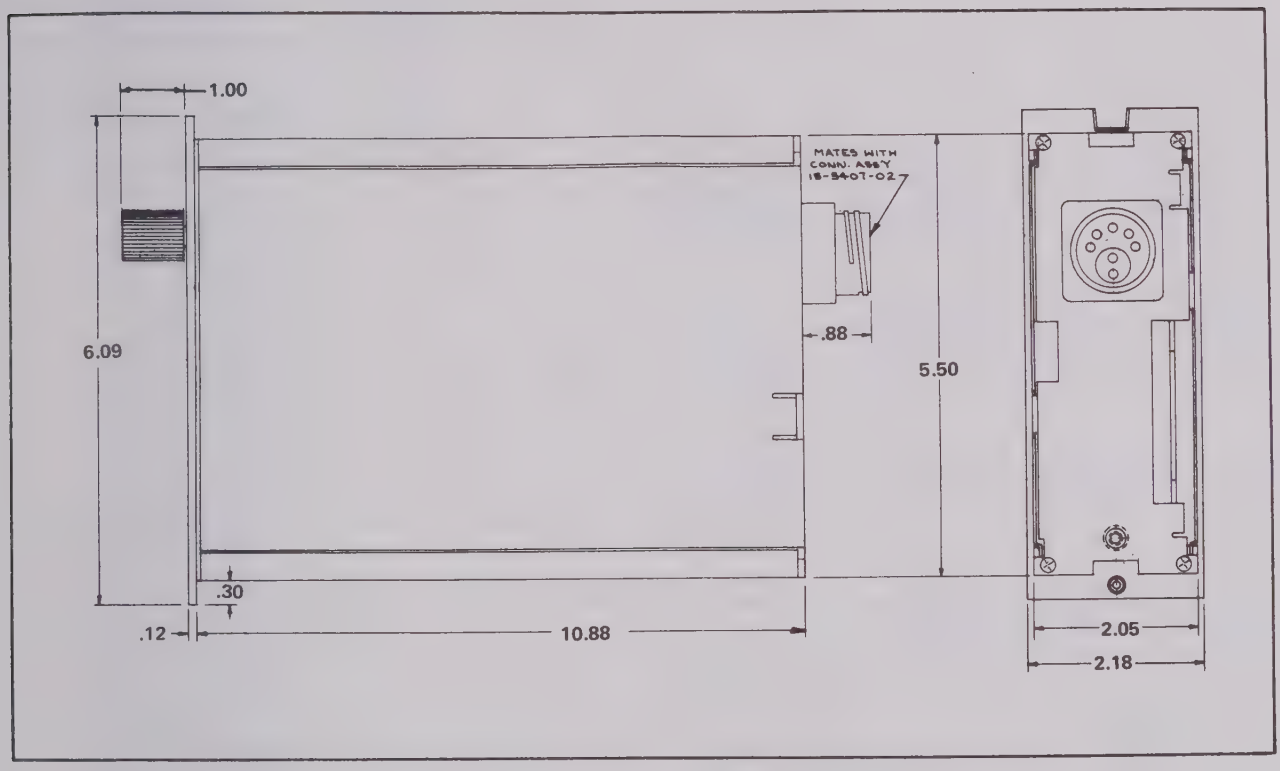



FIGURE 2-2 OUTLINE DIMENSIONS

# SECTION III

# OPERATION

## 3.1 GENERAL

This section describes and illustrates the controls of the Frequency Deviation Converter, Model 13-4618-00, and provides operating instructions. Before attempting to apply any signal to the converter it is imperative that the operator completely understand the functioning of the controls and the required input/output specifications.

## 3.2 FRONT PANEL CONTROLS

There are only two front panel controls. They are as follows:

| ITEM | CONTROL | DESCRIPTION |
|---|---|---|
| 1 | Deviation Range Switch (S101) . . . . . | This is a 9 position rotary selector switch which provides four full scale sensitivity ranges for any of the selected center frequencies. In a clockwise direction, the positions are as follows:<br><br>The first four positions select deviation ranges of ±0.5 Hz, ±1 Hz, ±2.5 Hz, and ±5 Hz, respectively, These ranges are for use when a center frequency of 50 or 60 Hz is selected.<br><br>The center position is "off". In this position the converter is not shut off, but the input signal is removed from the circuit. Pen position should be at chart center.<br><br>The last four positions select deviation ranges of ±50 Hz, ±25 Hz, ±10 Hz, and ±5 Hz, respectively. These ranges are for use when a center frequency of 400 Hz is selected. |
| 2 | Center Frequency Switch (S102) . . . . . | This is a 3 position switch which allows the operator to select either 50 Hz, 60 Hz, or 400 Hz as the input signal frequency. |

## 3.3 INTERNAL CONTROLS

The internal controls are not for operator use. See section IV for calibration instructions, if required.

## 3.4 APPLYING A SIGNAL TO THE CONVERTER

**CAUTION: BEFORE APPLYING A SIGNAL TO THE CONVERTER, VERIFY THAT THE INPUT VOLTAGE DOES NOT EXCEED THE SPECIFIED LIMIT OF 500 VOLTS RMS.**

### 3.4.1 General

This section lists the logical sequence of steps necessary to apply a signal to the converter.

a. Do not plug in modules until instructed.

b. Set DEVIATION RANGE switch to OFF.

c. Set CENTER FREQUENCY switch to the proper setting for the input signal frequency range.

d. Verify all recorder controls and settings, switch recorder main power "ON", and allow sufficient warm-up time.

e. Plug converter into rack and complete all input signal connections at the rear panel. See section II, Installation.

f. Select a slow chart speed.

g. Set PEN POSITION control so pen tracks in chart center.

h. Apply the input signal. Voltage must be 10 to 500 volts rms and be symmetrical about zero with zero crossover.

j. Set the DEVIATION RANGE switch to one of the positions designated for the input signal frequency (black for 50 or 60Hz, blue for 400Hz) and having the desired full scale sensitivity.

## 3.5 FUNCTIONAL TEST PROCEDURE

This procedure should be performed to verify operation and calibration of this unit. If the output is within the tolerance given, no calibration is required. If not, refer to Section IV of this manual.

a. Install preamplifier in carrying case or rack and connect AC signal source to input. Set input to 0 volts. Allow 30 minute warm-up time.

b. Turn CENTER FREQUENCY to 60 and RANGE to 0.5. Apply a 60Hz ±.001Hz signal to input. Output should be 0V ±100mv.

c. Change input to 59Hz ± .001Hz. Output should be -5V ±2.5mv.

d. Turn CENTER FREQUENCY off. Remove input signal. Unit is ready for use.

## 3.6 THEORY OF OPERATION

### 3.6.1 General

The Gould Frequency Deviation Converter Model 13-4618-00, is a single channel, plug in signal conditioner designed to be compatible with the 2000 Series Recorder Line. It measures the frequency deviation from a center frequency and outputs a 0 ±2.5 volt dc signal proportional to the deviation.

The center frequency switch on the front panel sets the center frequency to 50, 60 or 400Hz. The deviation range switch sets the outputs sensitivity to ±.5 to ±5 Hz for 50, 60 Hz operation or ±5 to ±50 Hz for 400Hz operation.

### 3.6.2 Input Circuit

The unit is designed to normally monitor power line frequencies and is independent of input voltage within a 10 to 500 volt rms range. The 10 volt rms level facilitates calibration of the unit but at this level the signal must be symmetrical about a 0 dc level. Figure 6.3 shows the schematic of the unit.

The input signal is applied to the active attenuator network R101, 102 and CR101, 102 to limit the ±.7 volt peak. The output voltage of T101 is shaped by the 741 comparator, U101, to be compatible with the $T^2$ L levels required by the 7400, U102. U102 constitutes two schmitt trigger circuits to obtain the fast rise and fall characteristics on the command and feed back frequencies required by the phase detector U104. U103 is used to count down the 400Hz input to a 50Hz signal.

### 3.6.3 Phase-Locked Loop

The operation of the frequency deviation converter is based on servo theory and is commonly referred to as a phased lock loop (PLL). A simplified block diagram of the PLL is shown in Figure 3-1.

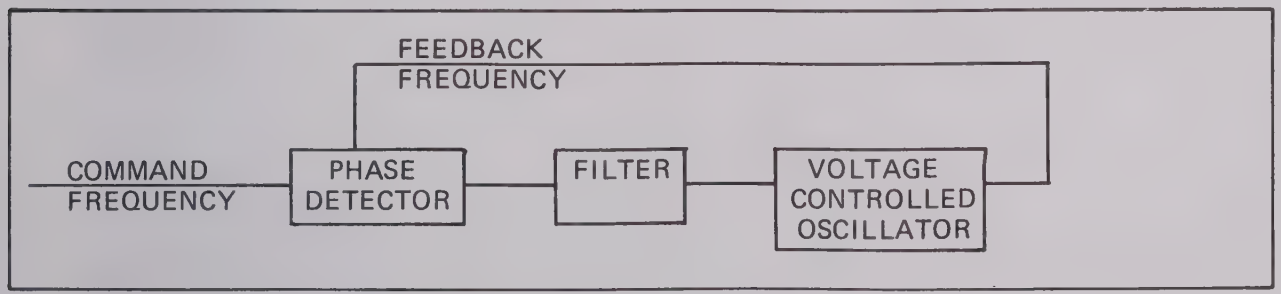



FIGURE 3-1 BLOCK DIAGRAM—PHASE-LOCKED LOOP

The phase detector compares the command and feed back frequencies and produces a pulse output whose duration and polarity is proportional to the phase difference between them. This signal is filtered and applied to the voltage controlled oscillator which converts the dc level to the feed back frequency. When the feed back frequency is equal to the command frequency and thier phase difference is zero, the pulse duration goes to zero and the output of the filter is held at the required voltage to produce the feed back frequency. U-105-1, U105-2 and U106-2 constitute the filter section of the block diagram. Symmetry, damping, noise and span controls are associated with the filter section to provide the necessary adjustments. The 50 and 60Hz center frequency adjustment is connected through R140 to U106. U105-3, U106-1 and 4 and the 4 transistors of U107 comprise the linear voltage controlled oscillator. U106-3 provides a zero crossover detector to produce the required feed back frequency.

### 3.6.4 Output Circuit

U105-4 and its associated circuitry provide the necessary gain changes for the deviation ranges.

# SECTION IV

# CALIBRATION

## 4.1 GENERAL

In addition to detailed calibration procedures, this section contains paragraphs on troubleshooting and maintenance.

**NOTE: This procedure is broken down into steps by individual adjustments. Under normal conditions, complete calibration should be performed every six months. After repair of the unit or some other change in the electronics, it is necessary only to recalibrate those circuits affected by the change.**

## 4.2 CALIBRATION

### 4.2.1 General

The Gould Frequency Deviation Converter, Model 13.4618-00, has been accurately calibrated before shipment from the factory and should give long trouble free service. Should recalibration be required, it should be performed by qualified technical personnel only.

CAUTION: CALIBRATION SHOULD NOT BE ATTEMPTED UNLESS SUITABLE, SPECIFIED TEST EQUIPMENT IS USED. SINCE SPECIAL, HIGH PRECISION EQUIPMENT IS REQUIRED, IT IS RECOMMENDED THAT THIS MODEL BE RETURNED TO THE FACTORY FOR RECALIBRATION.

**NOTE: Performance checks in this section specify limitations based on optimum "new-equipment" values. Should any results be unacceptable, please see the troubleshooting section of this manual or your Gould Service Representative.**

### 4.2.2 Test Equipment Required

The following is a list of test equipment necessary for calibration.

1. Extender card and cable assembly, Gould P/N 887291.
2. Digital Voltmeter: 4½ digit, 0.05% accuracy.
3. AC Source: Wavetek 110 or equal.
4. Frequency Counter — Gould Model TC17A or equal.
5. Oscilloscope: Gould Model OS3300B or equal.
6. 2000 series recorder.

### 4.2.3 Preliminary Procedure

a. Remove right side cover from preamp (Figure 4-1).

b. Attach signal input cable to frequency source, and card edge connector to power supply and Digital Voltmeter. Plus and minus power supply go to pins 4 and 3, respectively. Pins 1 and 5 are connected on the board, they are signal common and ground. Pin 2 is the dc output.

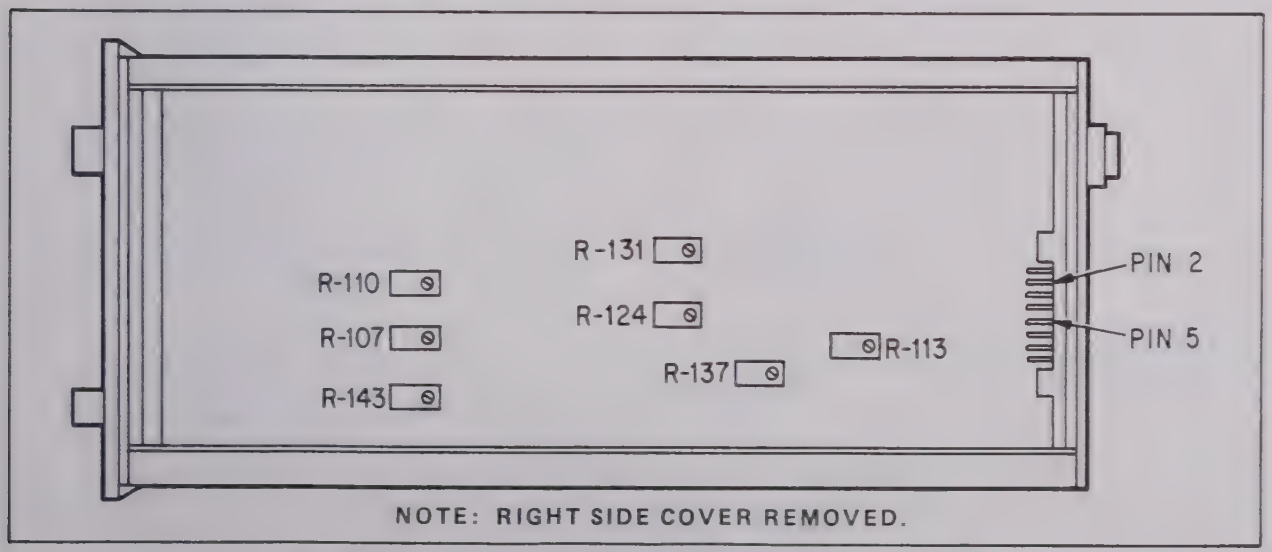



FIGURE 4-1 CALIBRATION COMPONENT LOCATION

c. Apply Power: +15vdc ±1 v. @ 100ma supply or power from a series 2000 recorder. Allow 30 minutes warmup.

**4.2.4 Output Zero Control Adjustment**

a. Set converter front panel control as listed below. CONTROL POSITION RANGE Switch OFF FREQUENCY Switch 60Hz

b. Using the digital voltmeter adjust the preamp zero control (R113) for an output of 0. ± 005vdc

**4.2.5 60Hz Control Adjustment**

a. Input: Enough voltage to have a square wave at U101 pin6 (above 3.5vac). Set the RANGE switch to the 5Hz position and apply a 55Hz frequency to the input.

b. Adjust the 60Hz control, R107, to obtain a -2.5 .01volt output on the digital voltmeter.

**4.2.6 Span Control Adjustment**

a. Change the input frequency to 65Hz and adjust the span control R143, to obtain a +2.5 ± .01volt output on the digital voltmeter.

b. Change the input frequency back to 55Hz and readjust the 60Hz control for a -2.5 ± .01volt output.

c. Repeat 4.2.6 to eliminate inter- action.

**4.2.7 Symmetry Control Adjustment**

Change the input frequency from 55 to 65Hz at a repetition rate of .1Hz. Using the scope, adjust the symmetry control, R124, for equal rise and fall times at the output within 3ms of each other. Symmetry is measured from the beginning to the end of the rise.

**NOTE:** On a VCG Generator set the frequency dial to 55Hz. Use a positive square wave from a second generator set at .1Hz. Connect the Second Generator to the First via the VCG input. Adjust the amplitude of the second generator for an output of 65Hz from the first generator. Use a counter or scope for monitoring.

**4.2.8 Damping Control Adjustment**

With the same frequency deviation as in 4.2.7, adjust the damping control, R137, to obtain a 95ms rise time at the output as displayed on.the scope.

**4.2.9 Noise Control ADjustment**

a. Set the input frequency to 60Hz and connect the output to a recorder. Set the RANGE switch to the 5Hz position and turn the noise control, R131, fully clockwise.

b. Connect a scope from TP3 (GND) to the right end of the filter capacitor, C101. Set the scope to the 5Mv/Div AC range.

c. Turn the noise control clockwise to reduce the noise level on the scope to a minimum.

**4.2.10 Span Control Readjustment**

a. Set the input frequency to 55Hz and read the output on a digital voltmeter to within ± .005volts.

b. Readjust the span control, R143, to obtain an output that is +2.5 ± .005 volts with respect to the reading at 55Hz. (CW increases span)

**4.2.11 60Hz Control Readjustment**

Readjust the 60Hz control, R107, to obtain 0 ± .01 volts at the output on the .5Hz range with 60Hz input.

**4.2.12 50Hz Control**

a. Turn the CENTER FREQUENCY switch to the 50Hz position and change the input frequency to 50Hz.

b. Adjust the 50Hz control, R110, to obtain a 0 ± .01 volt output.

c. Turn the CENTER FREQUENCY switch to 400Hz and the RANGE switch to the blue 5 cycle position. The output should be 0 ± .015 volts with an input frequency of 400Hz.

**4.3 SYSTEM CALIBRATION CHECK**

**4.3.1 Zero and Span**

a. Turn the RANGE switch to OFF and determine that the output is 0 ± 10mv with a digitial voltmeter.

b. Connect a 10 volt rms 60 ± .001 Hz signal to the input. Turn the CENTER FREQUENCY switch to 60 and the RANGE switch to the .5 position.

c. The output voltage should be 0V ± 100mv.

4.3.2 Range Switch

a. Turn the CENTER FREQUENCY switch to 60Hz and the RANGE to .5. Apply a 59 & 60±.001Hz signal to the input. The difference in output read on a digital voltmeter should be 5.0 ± .025 volts.

b. Rotate the RANGE switch clockwise to the next position and repeat step a, above. The output should read as follows:

| RANGE POSITION | OUTPUT | |
|---|---|---|
| 1.0 | -2.5 | ±12.5mv |
| 2.5 | -1 | ±5mv |
| 5.0 | - .5 | ±2.5mv |

c. Repeat b, above using 390Hz with a center frequency of 400Hz.

| RANGE POSITION | OUTPUT | |
|---|---|---|
| 5 | -5 | ±30mv |
| 10 | -2.5 | ±15mv |
| 25 | -1 | ±7.5mv |
| 50 | - .5 | ±3mv |

4.3.3 Noise

Turn the RANGE switch to the .5Hz position and the CENTER FREQUENCY switch to 60Hz. Apply 60 ±.001Hz to the input. Monitor the output with a recorder or a scope. The noise level should be less than 10 mv rms.

4.3.4 Step Response

Turn the RANGE switch to the black 5Hz position and the CENTER FREQUENCY to 60Hz. Apply a step change in frequency to the input at a repetition rate of .1Hz and a deviation of 55 to 65Hz. Measure the rise and fall times at the output with a scope. The rise and fall times of the step response should be less than 100ms.

4.3.5 Input Voltage Amplitude

a. Apply a variable amplitude 60 ±.001Hz signal to the input. Set the RANGE switch to .5Hz and the CENTER FREQUENCY switch to 60Hz.

b. Vary the input amplitude from 10 volts rms to 500 volts rms. The output should be independent of the input voltage amplitude.

4.3.6 Common Mode Rejection

a. Apply a 10 volts rms 50Hz signal with a common mode voltage of 50 volts rms @ 60Hz to the input. Set the RANGE switch to .5Hz and the CENTER FREQUENCY to 50Hz.

b. The output on a recorder or a scope should be 0 volt dc with less than 50mv of ripple for a 60Db CMR.

## 4.4 TROUBLESHOOTING

Troubleshooting may be performed in conjunction with the schematic (located after the parts section) and the bench equipment listed in paragraph 4.2.2. When the converter is used with a Gould 2000 Series Recorder, refer to the troubleshooting table in Section V of the recorder manual.

## 4.5 MAINTENANCE

4.5.1 General

Maintenance on the converter is limited to cleaning only.

CAUTION

a. BEFORE ATTEMPTING TO CLEAN CONVERTER, TURN OFF POWER AND REMOVE FROM ENCLOSURE.

b. AVOID USE OF CHEMICAL CLEANING AGENTS WHICH MIGHT DAMAGE PLASTIC OR PRINTED SURFACES. DO NOT USE CHEMICALS WHICH CONTAIN TOLUENE, CELLUSOLVE, ACETONE OR SIMILAR SOLVENTS.

4.5.2 Exterior

Remove loose dust with a soft cloth or small paint brush. Dirt which remains can be removed with a soft cloth dampened in mild detergent and water solution. DO NOT USE ABRASIVE CLEANERS.

4.5.3 Interior

Dust in the interior should be removed occasionally due to its electrical conductivity under high humidity conditions. Blow off accumulated dust with dry low pressure air. Remove any dirt which remains with a soft paint brush or a soft cloth dampened in a mild detergent and water solution. Use a cotton-tipped applicator for cleaning in narrow spaces and/or printed circuit boards.

# SECTION V

# PARTS IDENTIFICATION

## 5.1 GENERAL

This instrument has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Gould Service Engineer listed on the warranty card shipped with the instrument.

The following parts lists and schematic diagrams are designed to assist in servicing and repairing the instrument.

**NOTE: Check to be sure the schematic number and revision letter stamped on the rear of the instrument agree with the number and revision letter on the schematic contained in this section.**

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name, model number, and serial number of the instrument.

   For Example: Frequency Deviation Converter Model 13-4618-00 Serial Number_____

2. Description of the part as listed in the manual.

3. Gould part number.

**NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.**

**GOULD FREQUENCY DEVIATION CONVERTER**
**MODEL 13-4618-00** and 13-G4618-00
**FIGURE 5-1**

| ITEM NO | PART NUMBER | DESCRIPTION | | SYMBOL NO |
|---|---|---|---|---|
| 1 | 787528 | Panel Assembly, Silkscreen | CL-710621 | * |
| 2 | 685944-1 | Frame | | |
| 3 | 285652-2 | Knob | 285652-11 | * |
| 4 | 285652-1 | Knob | 285652-12 | * |
| 5 | 787880 | Switch Assembly, Rotary | | S102 |
| 6 | 785946 | Panel Assembly, Rear | | |
| 7 | 687874 | Connector Assembly | | J101 |
| 8 | 387509 | Panel, Sub | | |
| 9 | 686421 | Cover Assembly, Left Side | | |
| 10 | 285943 | Cover, Right Side (Not Shown) | | |
| 11 | 247523-124 | Plate, Identification | 247523-360 | * |
| 12 | 887886 | Board Assembly (See Fig. 5-2) | | |
| 13 | 11-5407-02 | Connector, Male (Not Shown, Mates with J101) | | P101 |

* used on 13-G4618-00

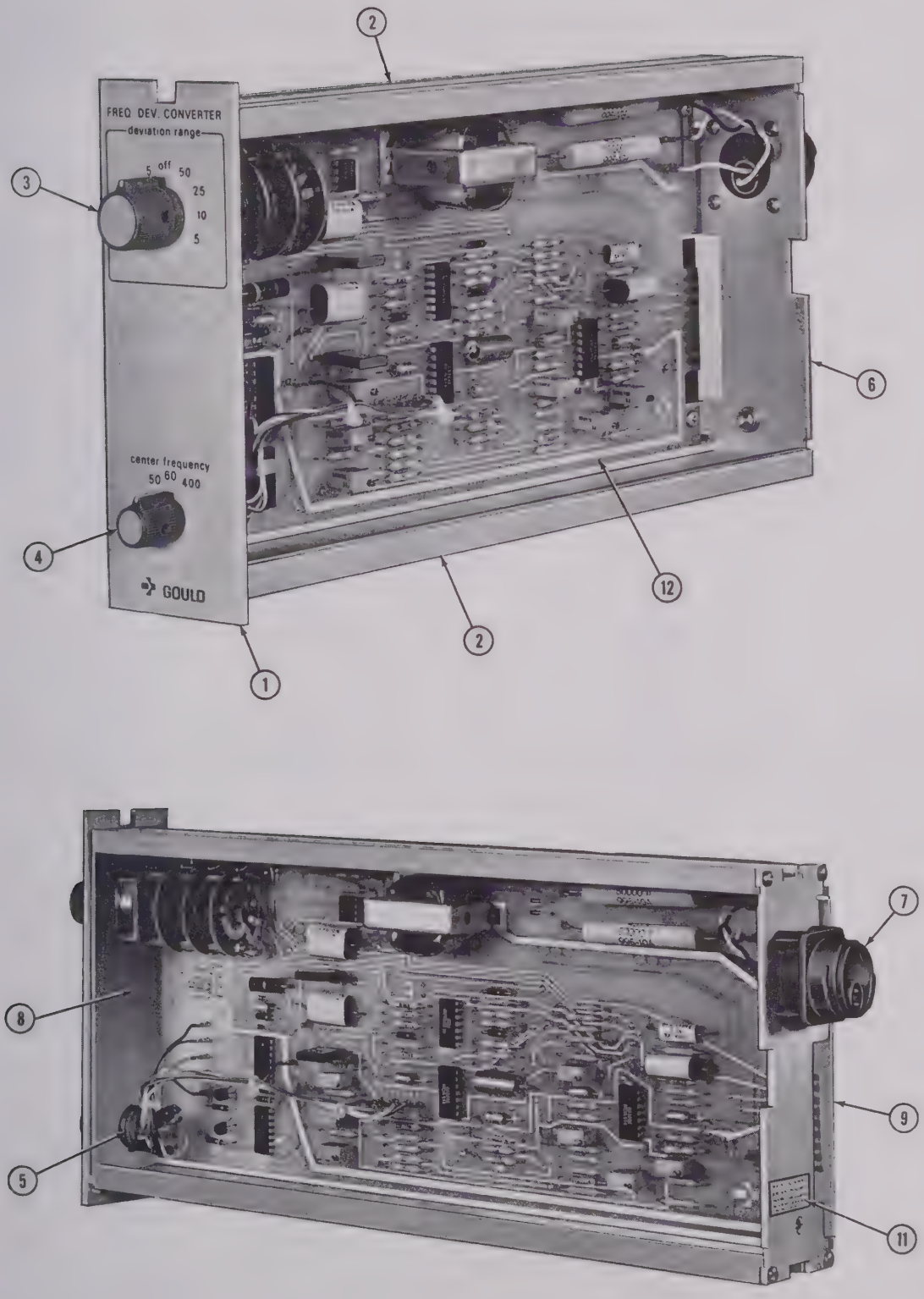



FIGURE 5-1 FREQUENCY DEVIATION CONVERTER

GOULD FREQUENCY DEVIATION CONVERTER, MODEL 13-4618-00
ELECTRICAL PARTS LIST
AMPLIFIER BOARD ASSEMBLY (887886)
FIGURE 5-2

| SYMBOL NO | PART NUMBER | DESCRIPTION |
|---|---|---|
| C101 | 5-241145-104 | Capacitor |
| C102 | 5-241145-504 | Capacitor |
| C103 | 2-287730-474 | Capacitor |
| C104 | 10-241145-504 | Capacitor |
| C105, C106 | 262585-106 | Capacitor |
| C107 | 10-241145-504 | Capacitor |
| C108 thru C110 | 262585-106 | Capacitor |
| CR101, CR102 | 280440 | Diode |
| CR103, CR104 | 241133 | Diode |
| CR105 | 269256-7 | Diode |
| CR106 | 241133 | Diode |
| CR107, CR108 | 280440 | Diode |
| R101, R102 | 5-118180-503 | Resistor |
| R103, R104 | 5-241111-103 | Resistor |
| R105 | 5-241111-105 | Resistor |
| R106 | 25-284694-50000 | Resistor |
| R107 | 269085-102 | Resistor, Variable |
| (R108 REF) W1 | | Jumper |
| R109 | 25-284694-50000 | Resistor |
| R110 | 269085-102 | Resistor, Variable |
| (R111 REF) W2 | | Jumper |
| R112 | 25-284694-15000 | Resistor |
| R113 | 269085-103 | Resistor, Variable |
| R114 | 25-284694-10002 | Resistor |
| R115, R116 | 25-284694-50001 | Resistor |
| R117 | 25-284694-40001 | Resistor |
| R118 | 25-284694-10001 | Resistor |
| R119 | 5-241111-472 | Resistor |
| R120, R121 | 5-241111-103 | Resistor |
| R122 | 5-241111-472 | Resistor |
| R123 | 25-284694-10001 | Resistor |
| R124 | 269085-502 | Resistor, Variable |
| R125 | 25-284694-20000 | Resistor |
| R126 | 25-284694-10001 | Resistor |
| R127 | 25-284694-20001 | Resistor |
| R128 | 25-284694-18001 | Resistor |
| R129 | 25-284694-20000 | Resistor |
| R130 | 25-284694-10003 | Resistor |

GOULD FREQUENCY DEVIATION CONVERTER, MODEL 13-4618-00
ELECTRICAL PARTS LIST
AMPLIFIER BOARD ASSEMBLY (887886)
FIGURE 5-2 (Continued)

| SYMBOL NO | PART NUMBER | DESCRIPTION |
|---|---|---|
| R131 | 269085-103 | Resistor, Variable |
| R132, R133 | 25-284694-20001 | Resistor |
| R134 | 25-284694-40000 | Resistor |
| R135, R136 | 25-284694-20001 | Resistor |
| R137 | 269085-202 | Resistor, Variable |
| R138 | 25-284694-20000 | Resistor |
| R139, R140 | 25-284694-10001 | Resistor |
| R141 | 25-284694-50001 | Resistor |
| R142 | 25-284694-50000 | Resistor |
| R143 | 269085-202 | Resistor, Variable |
| R144 | 25-284694-20000 | Resistor |
| R145 | 25-284694-10000 | Resistor |
| R146 | 25-284694-15001 | Resistor |
| R147 | 25-284694-10001 | Resistor |
| R148 | 25-284694-50000 | Resistor |
| R149 | 25-284694-10001 | Resistor |
| R150 | 5-241111-472 | Resistor |
| R151 | 25-284694-10001 | Resistor |
| R152 | 25-284694-50000 | Resistor |
| R153 | 25-284694-10001 | Resistor |
| R154, R155 | 25-284694-20000 | Resistor |
| R156, R157 | 25-284694-60000 | Resistor |
| R158 | 25-284694-20000 | Resistor |
| R159, R160 | 5-241111-202 | Resistor |
| R161 | 25-284694-20000 | Resistor |
| R162, R163 | 25-284694-10001 | Resistor |
| R164 | R1-284694-10000 | Resistor |
| R165 | R1-284694-613R7 | Resistor |
| R166 | R1-284694-203R9 | Resistor |
| R167 | R1-284694-202R8 | Resistor |
| R168 | 5-115558-620 | Resistor |
| R169 | 5-241111-472 | Resistor |
| S101 | 287523 | Switch |
| T101 | 287736 | Transformer |
| U101 | 286020 | Integrated Circuit |
| U102 | 281103 | Integrated Circuit |
| U103 | 270622 | Integrated Circuit |
| U104 | 287901 | Integrated Circuit |
| U105, U106 | 287740 | Integrated Circuit |
| U107 | 287602 | Transistor |
| U108 | 287496 | Voltage Regulator |
| U109 | 291593 | Voltage Regulator |

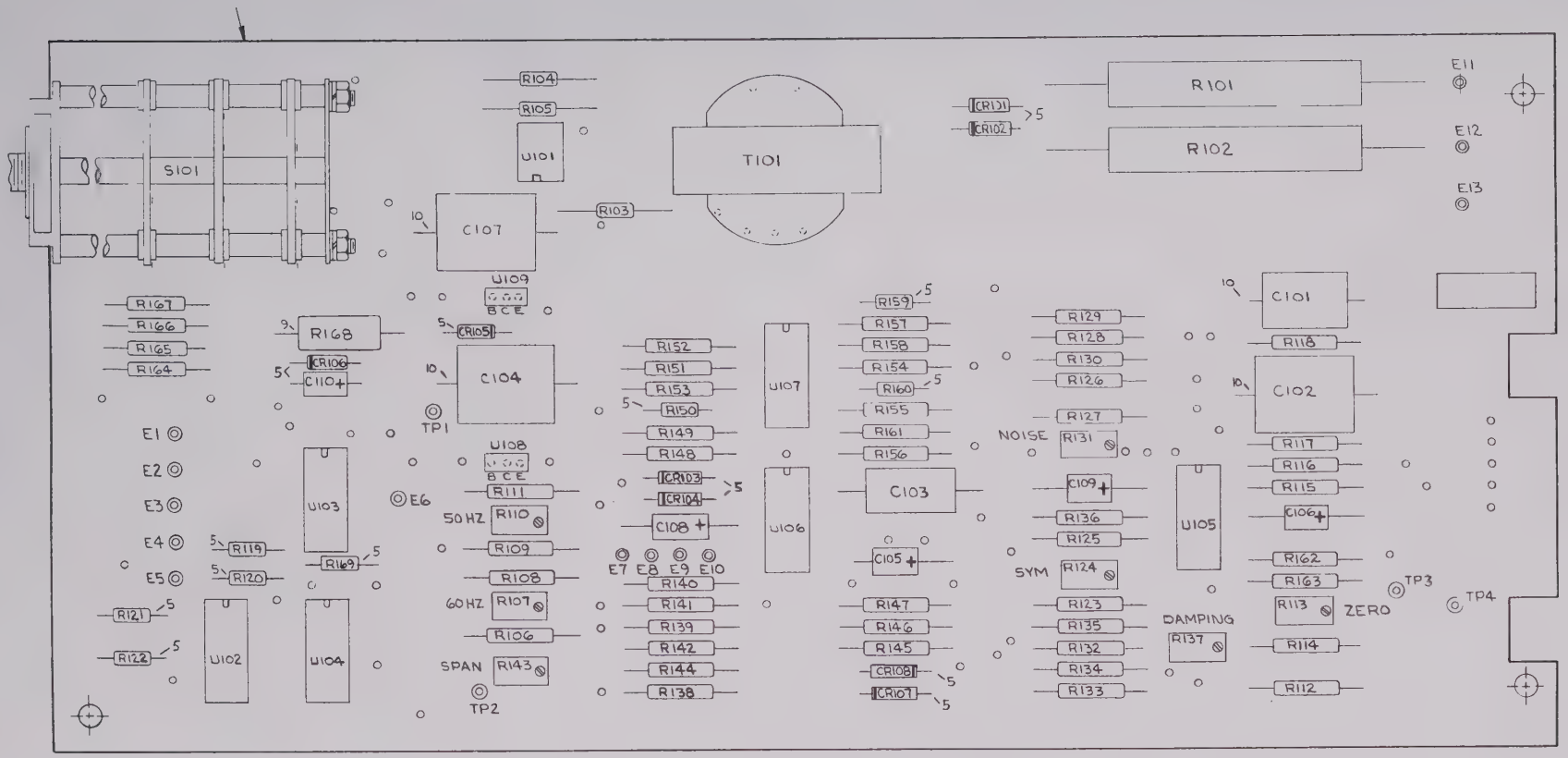
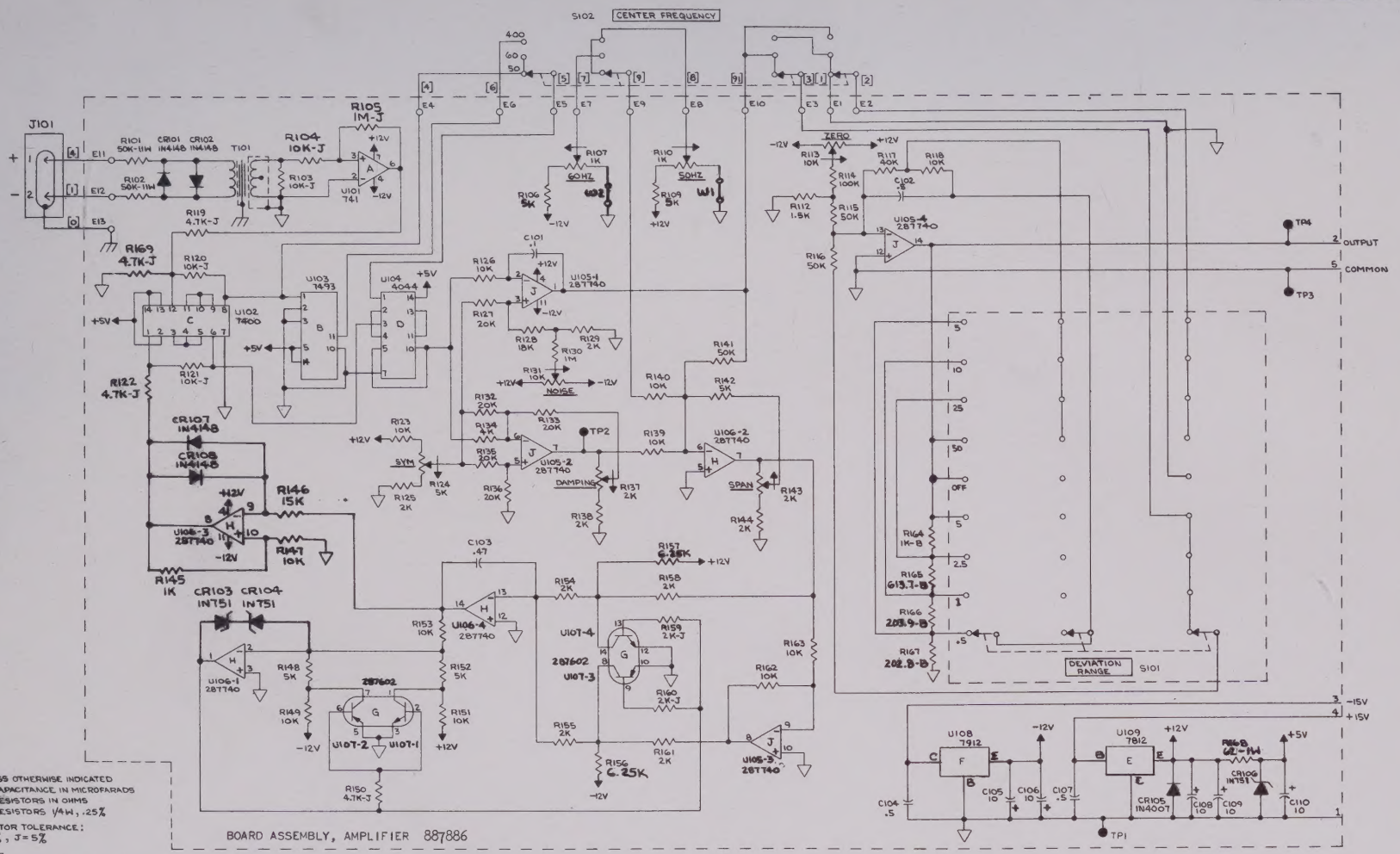



FIGURE 5-2 BOARD ASSEMBLY 887886




1. UNLESS OTHERWISE INDICATED
   ALL CAPACITANCE IN MICROFARADS
   ALL RESISTORS IN OHMS
   ALL RESISTORS 1/4W, .25%
2. RESISTOR TOLERANCE:
   B = 1%, J = 5%
3. [ ] = FRONT PANEL CONTROL
4. ARROW INDICATES CW ROTATION
5. [ ] = E.I.A. COLOR CODE

| REVISIONS | | | |
|---|---|---|---|
| REVS. | DESCRIPTION | DATE | APPROVAL |
| A-1 | REV. CIRCUIT DCN 21671 | 6-3-74 | CZECH |
| B-1 | REV. CIRCUIT DCN 22145 | 11-1-74 | CZECH |
| C | REV. CIRCUIT DCN 35296 | 11-80 | CLARK |

AMPLIFIER ASSEMBLY, FREQ. DEV. CONVERTER

| BY | DATE | NAME | SCHEMATIC |
|---|---|---|---|
| DR. CZECH | 9/11/73 | MODEL NO. 13-4618-00 | |
| CHK. | 10/1/73 | | |
| APP. | | CODE IDENT. 98795 | SIZE D |

Gould Inc. Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
DWG NO. 287318

Form 2.7 3-71

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